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ABSTRACT

The preliminary trial of a program in which principles of patient-computer dialogue have been applied to dietary counseling is described. The program was designed to obtain historical information from overweight patients and to provide instruction and guidance regarding dietary behavior. Beginning with a teaching sequence, 25 non-overweight participants responded to 375 questions (items) on the cathode-ray screen. Questions were divided into three sections: dietary history, analysis of food intake for a usual day, and diet and menu planner. As questions appeared on the screen, the participants read them aloud, explained their understanding to an assistant, and answered at the keyboard. This initial trial sought to study the process of dietary interviews by computer, the read-aloud procedure served to uncover defects in word choice, instructions, and interview strategies. Difficulties in understanding were evident in 12% of the items. Use of the keyboard evoked more difficulties than favorable reactions (7% vs. 4%) during the teaching sequence, whereas favorable responses to the keyboard were more frequent than difficulties (2% vs. 1%) during the dietary sections. While the computer interviews demand clarity and structure from the writer of the program, they do facilitate the writing and revision by compiling a complete and detailed record of the interview. Despite the difficulties of a limited choice of responses, ambiquities and hidden meanings in the questions, and matters of courtesy, cumulative refinements of the interview will lead, eventually, to a standardized counseling system of known performance. (DAG)

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A Computer-Based Dietary Counseling System

Warner Slack And Others

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A computer-based dietary counseling system[1]

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The authors describe the design and development of a computer-based dietary counseling system. The process of dietary interviewing is discussed in the light of a preliminary clinical trial.

Computer-based medical histories designed to perform some of the functions of the professional interviewer have been written for a variety of medical fields (1-5), and an automated interview to collect dietary information for patients with diabetes has been reported (6). In some of these programs, computer-based instruction is used for teaching patients how to operate the computer, for conveying the meaning of questions that are not understood initially, and for providing information deemed relevant to the patient's health (7). In this article, the preliminary trial of a program in which principles of patient-computer dialogue have been applied to dietary counseling is described. The program was designed to obtain historical information from overweight patients and to provide instruction and guidance regarding dietary behavior.

We hope that refinement and extension of this program will lead to interviews that pertain to multiple clinical areas and are of demonstrable value to the dialogue between patients and their nutritionists. A long-range goal is to create counseling programs that are suitable for use by patients to whom professional guidance is unavailable.

Methods

THE COMPUTER. A PDP-15 computer in Cambridge, Massachusetts, communicated with cathode-ray screen terminals in Boston at the Harvard Community Health Plan[6] and the Computer-Medicine Laboratory of the Beth Israel Hospital[7]. The computer interacted with volunteer participants by questions and suggestions presented on the cathode-ray screen, and participants responded by pressing one or more keys on a typewriter-like keyboard. Among many possible pathways through each interview, the course taken was determined by the participant's responses. All responses were stored on magnetic disc and used to select text for presentation on the terminal and to collect summary statements to be printed after the interview.

THE COUNSELING SYSTEM. The program contains 375 questions, explanations, and requests that are divided into three sections: "Dietary History," "Analysis of Food Intake for a Usual Day," and "Diet and Menu Planner." The program begins with a self-instructional sequence that teaches interaction with the computer and establishes the user's identity.

The section on "Dietary History" contains questions that characterize eating behavior, determine weight patterns, and define problems relative to loss or control of weight. About 30 min. are needed to complete the history. Figure 1 shows a computer printout that summarizes and coordinates the information gathered in the interview. This summary is generated for concurrent use by patient, physician, and nutritionist. If requested by the patient, the computer suggests ways to decrease caloric intake, techniques for behavioral control of eating, and ways to increase activity.

The second section, "Analysis of Food Intake for a Usual Day," assists the patient in sequentially listing all foods eaten at meals and snacks during a usual day and in estimating the quantities. An example of dialogue and branching patterns for a breakfast and a snack appears in Figure 2. The lunch, or mid-day meal, is identified in a format similar to the breakfast or snack, except that the components from which specific food items are identified have been changed to main dish, soup, salad, vegetables, bread, potatoes, dessert, and beverage. The same categories, as well as cocktails, appetizers, and cooked vegetables, are used to determine dinner or main-meal selections.

As the dialogue relating to each meal or snack is concluded, the computer asks the patient if it has "forgotten anything." Additional examples of meals or main dishes may be reported if the patient needs further opportunity to characterize a widely varying food intake. Calorie tabulations are made from the information reported and are shown for each food

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[6]"Harvard Community Health Plan: An Assessment at the Five Year Mark," available from Joseph L. Dorsey, M.D., Harvard Community Health Plan, 690 Beacon Street, Boston 02115.

[7]Communication was by voice-grade telephone lines at the transmission rate of 300 band.

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DEPARTMENT OF MEDICINE - BETH ISRAEL HOSPITAL - HARVARD MEDICAL SCHOOL
DEPARTMENT OF NUTRITION - HARVARD SCHOOL OF PUBLIC HEALTH

RE: MR. UPTON PLENUM
33 WATER ST.
PODUNK, MASS. 01984

DATE: OCT 16, 1975

BORN: July 4, 1926

COMPUTER BASED NUTRITION HISTORY

I. PERSONAL HISTORY AND HABITS

A. GENERAL
-EMPLOYED FULL TIME
-USUAL ACTIVITY: SITS; WALKS (ONE WAY) 1-2 BLOCKS TO WORK OR SCHOOL
B. ACTIVITY
-MOST ACTIVE IN SUMMER
-COMMONLY: GOLFS OR BOWLS; GARDENS OR DOES WORK AROUND THE HOUSE
-FREQUENCY: AS TIME PERMITS
C. PHYSICAL DESCRIPTION
-WEIGHT AT AGE 20-25: "165" LBS.
-PRESENT WGT: "195" LBS. (CONSIDERED OVERWEIGHT); HGT: "5" FT. "11" IN.
-CONSIDERS "170" LBS. AS BEST WGT.
-MAX. ADULT WGT: "196" LBS. AT AGE "48"; MIN. ADULT WGT: "160" LBS. AT AGE "19"
-BODY TYPE: "S"; FRAME: LARGE
D. WEIGHT HISTORY
-SELF-CONCEPTION: PRETEEN - SKINNY; TEENAGER - ABOUT RIGHT
-OVERWGT FAMILY MEMBERS: MOTHER; WIFE
-IN PAST 6 MONTHS: NO CHANGE (>10 LBS.)
-WGT. REDUCTION TRIED IN PAST YEAR; SUGGESTED BY: SELF; DOCTOR
HELP RECEIVED FROM: FRIEND; MAGAZINE
-MAX. LOSS ON A DIET: 10 OR LESS LBS. (AND REGAINED THIS WGT. 1-6 MONTHS LATER)
-WANTS TO LOSE WGT.
-RELATES WGT. PROBLEM TO: EATING SCHEDULES OR EXCESSES; STRESS OR EMOTIONAL FACTORS
E. CURRENT DIET PRACTICES
-PRESENTLY USES: NO CERTAIN DIET; NONE OF THE LISTED INJECTIONS, PILLS, ETC.
F. SMOKING HISTORY
-FORMERLY SMOKED CIGARETTES, HAS QUIT WITH AN ASSOCIATED GAIN OF 5-10 LBS.

II. FOOD HABITS AND PREFERENCES

A. VITAMIN/MINERAL SUPPLEMENTS
-REGULARLY USES: MULTIVITAMINS; VIT. C; NOT PRESCRIBED BY A DOCTOR
B. MEAL AND SNACK PATTERNS
-WHEN HOME, RARELY PREPARES OWN MEALS
-EATS 3 MEALS EACH DAY: BREAKFAST, LUNCH, DINNER; MOST FOOD IN EVENING
-SNACKS: MORNINGS, AFTERNOONS, LATE EVENING OR BEDTIME (USUALLY NOT ALONE)
-WHILE EATING: OFTEN WATCHES TV OR READS
-ON WEEKENDS: EATS MORE FOOD; EATS MORE SNACKS
C. BINGE PATTERNS
-DOES BINGE; ASSOCIATED WITH: BOREDOM, HOLIDAYS, ANXIETY OR WORRY
-PREFERS: WHATEVER IS AVAILABLE; COMMONLY EATS: ICE CREAM, COOKIES, ALCOHOLIC DRINKS
D. CHANGES IN FOOD HABITS
-OBSERVES: A CHANGE IN EATING TIMES
-CHANGE IS RELATED TO: CHANGE OF OCCUPATION OR WORK HRS; CHANGE OF FAMILY STRUCTURE
E. PREFERENCES
-DISLIKES: "SHRIMP"
-CULTURAL AND RELIGIOUS DIETARY RESTRICTIONS: NONE DECLARED
F. APPETITE
-DESCRIPTION: USUALLY HUNGRY AT MEAL OR SNACK TIMES
-CONTROL: WHEN EATING CAN USUALLY STOP

III. WEIGHT TIPS THAT MIGHT BE HELPFUL FOR MR. UPTON PLENUM

A. ACTIVITY
-TRY SPENDING MORE TIME IN RECREATIONAL ATHLETICS
-TAKE THE STAIRS INSTEAD OF THE ELEVATOR
B. ACCESS TO FOOD
-TRY EATING ONLY AT THE TABLE
-BETTER NOT TO WATCH TV OR READ WHILE EATING
-DIET SUCCESS IN PAST INDICATES HOPE FOR FUTURE
C. FOOD CHOICES
-HAVE SUBSTITUTES HANDY IN PLACE OF USUAL CHOICES (BUT REMEMBER TO LIMIT PORTIONS)
FOR ICE CREAM USE SHERBERT OR ICE MILK
FOR COOKIES, USE WAFERS OR GRAHAM CRACKERS

FIG. 1. *Computer summary of the dietary history.*

item, each meal, and the total for the day (Figure 3).

The "Diet and Menu Planner" uses a modification of the original diabetic Exchange Lists (8). Interacting with the computer, the respondent can plan, meal by meal, menus for one or more days within a range of 1,200 to 1,700 kcal per day. A computer printout of a sample meal plan for one day is shown in Figure 4.

READ-ALOUD PROCEDURE. Twenty-five volunteers, eight men and seventeen women who had expressed interest in the program, participated in trials of the computer interview prior to its use with overweight patients. The participants were encouraged to comment on any difficulties they encountered with the interview questions.

As questions appeared on the screen, the participants read them aloud, explained their understanding to an assistant and answered at the keyboard. The assistant recorded events of note—comments, questions, and problems with their resolution—and provided any help that was needed by the volunteer.

The purpose of this initial trial was to study the process of dietary interviewing by computer; the read-aloud procedure served to discover defects, such as obscure, poorly worded, or unclear questions or instructions, and illogical or generally unsuitable interviewing strategies.

Results

The participants used 375 different interview items, some repeatedly and others only once or twice (range, 1 to 76), indicating considerable individualization by the program. The average number of items presented during an interview was 216 (range, 94 to 252), which demonstrated adaptability in both length and topical coverage.

The assistants recorded 966 events of note for an average of 18 per cent of the items presented during an interview. Difficulties, such as misunderstandings, inappropriate answers, and needs for help in answering, were recorded for 12 per cent of the items. Favorable reactions, including unsolicited comments by the participants, were noted with 6 per cent of the interview questions.

The unfavorable and favorable responses were classified as pertaining to use of the keyboard or understanding of the interview, and as occurring during the initial teaching sequence or the dietary sections of the interview. Table 1 shows the results.

The total percentage of events noted was similar for both parts of the interview: During the teaching part, 11 per cent of the events related to the keyboard and 9 per cent to understanding; during the dietary sections, 15 per cent of the events pertained to understanding and 3 per cent to keyboard usage. This pattern suggests that keyboard skills acquired during the teaching sequence were applied during the balance of the interview, when misunderstandings of content would be expected.

Use of the keyboard evoked more

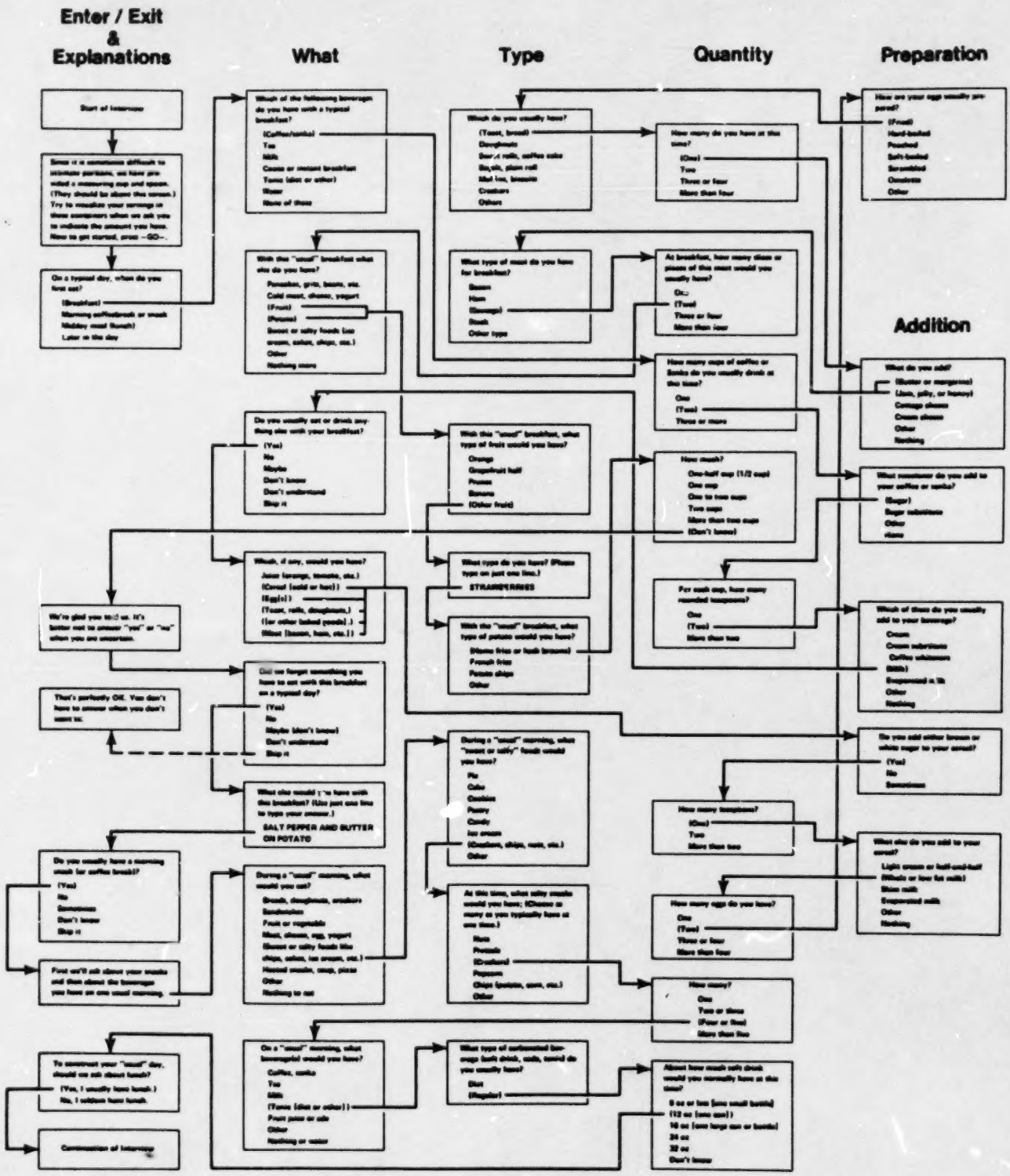

FIG. 2. *Diagram of some alternate pathways through the "usual day" interview.*

RE: MR. UPTON PLENUM
33 WATER ST.
PODUNK, MASS 01984

DATE: OCT 16, 1975
BORN: JUL 4, 1926

INTAKE AND CALORIC ESTIMATES FOR A "USUAL" DAY

INTAKE ON A "USUAL" DAY	CALORIE (AMOUNT)	FOOD AMT.	FOOD CAL.
A. BREAKFAST			
-TEA: 2 CUPS	5 (1 CUP)	2	10
SUGAR: 1 TEASPOON	15 (1 TSP)	2	30
MILK	11 (1 TBL)	2	22
-SOFT-BOILED EGG(S): 1	78	1	78
-TOAST OR BREAD: 1	63	1	63
BUTTER OR MARGARINE	33 (1 TSP)	1	33
-BACON: 1 PIECE	43 (1 SLICE)	1	43
-GRAPEFRUIT HALF	52	1	52
	TOTAL BREAKFAST CALORIES:		331
B. MORNING SNACK			
-COFFEE OR SANKA: 1 CUP	2 (1 CUP)	1	2
SUGAR: 1 TEASPOON	15 (1 TSP)	1	15
CREAM SUBSTITUTE: 1 OR LESS TABLSP	44 (1 TBL)	1	44
	TOTAL MORNING SNACK CALORIES:		61
C. LUNCH			
-EGG, FISH, OR MEAT SALAD PLATE	267 (1 SERV.)	1	267
-BAGELS OR PLAIN ROLL: 1	113	1	113
BUTTER OR MARGARINE	33 (1 TSP)	1	33
-COFFEE OR SANKA: 1 CUP	2 (1 CUP)	1	2
SUGAR: 1 TEASPOON	15 (1 TSP)	1	15
CREAM SUBSTITUTE: 1 OR LESS TABLSP	44 (1 TBL)	1	44
	TOTAL LUNCH CALORIES:		474
D. AFTERNOON SNACK (LATE AFTERNOON)			
-CANDY BAR: 1	296 (1 MED.)	1	296
	TOTAL AFTERNOON SNACK CALORIES:		296
E. EVENING MEAL			
-GIN, BOURBON, ETC: 1	164 (1 DRINK)	1	164
-NUTS	177 (1 OZ)	1	177
-BEEP STEAK: 4-8 OZ.	42 (1 OZ)	6	252
FAT: IF CRISPY			
SOMETIMES FRIED			
-TOSSED OR LETTUCE AND TOMATO SALAD	19 (1 CUP)	1	19
FRENCH DRESSING: 1 TABLESPOON	72 (1 TBL)	1	72
-BAKED POTATO: 1	93 (1 MED)	1	93
SOUR CREAM	32 (1 TBL)	1	32
-BAGELS OR PLAIN ROLL: 1	113	1	113
BUTTER OR MARGARINE	33 (1 TSP)	1	33
-REGULAR ICE CREAM: 1 SCOOP	158 (1 SCOOP)	1	158
-COFFEE OR SANKA: 2 CUPS	2 (1 CUP)	2	4
SUGAR: 1 TEASPOON	15 (1 TSP)	2	30
CREAM SUBSTITUTE: 1 OR LESS TABLSP	44 (1 TBL)	2	88
	TOTAL EVENING MEAL CALORIES:		1235
F. EVENING SNACK (DURING EVENING ACTIVITIES)			
-CHIPS: 1-2 CUPS	46 (⅛ CUP)	3	138
-BEER: 2	171	2	342
	TOTAL EVENING SNACK CALORIES:		480
	TOTAL USUAL DAY CALORIES:		2877

FIG. 3. *Computer summary of the "usual day" interview.*

difficulties than favorable reactions (7 vs. 4 per cent) during the teaching sequence, whereas favorable responses to the keyboard were more frequent than difficulties (2 vs. 1 per cent) during the dietary sections. Eighty-eight per cent of the favorable reactions to the keyboard in the dietary sections pertained to the BACK UP and CHANGE keys, suggesting that initial difficulty in learning to use the keyboard was more than offset by the flexibility these keys added to the balance of the interview.

Difficulties in understanding were more frequent than favorable reactions (11 vs. 3 per cent) during the dietary sections of the interview, which were undergoing preliminary trial. In the teaching sequence, which had benefited from previous usage with other types of medical interviewing (7), difficulties and favorable reactions were almost balanced (5 vs. 4 per cent).

Unfavorable and favorable responses were examined in different areas of the dietary sections of the interview (Table 2). Open-ended questions, which required the volunteers to type free text, evoked the largest percentage of responses of either type; difficulties arose because of additional typing, along with favorable reactions because of the added freedom of choice. Questions about exercise and activities evoked the smallest percentage of favorable reactions. The favorable reactions volunteered by participants to such words of encouragement as "We hope we can help" and "Are you getting hungry?" suggest that items focusing on the participants' feelings may serve an important function for some users of the interview.

Discussion

In the United States, heightened awareness of the medical implications of nutrition has led to a greater demand for nutritionists' services. Indications are that the present shortage of persons in dietetic practice will increase markedly during the next few years. The Study Commission on Dietetics estimated that 25,000 clinical practitioners, or an annual level of 2,500 college graduates in dietet-

BASIC MEAL PLAN MODEL
CHOSEN BY MR. UPTON PLENUM

FOOD TYPE	NUMBER OF SERVINGS	FOOD: AMOUNT	CALORIES
BREAKFAST			
PROTEIN	1/2	EGG: 1	78
STARCH	1/2	MUFFIN: 1/2 SMALL	59
FAT	1	WITH BUTTER OR MARGARINE: 1 TSP	33
FRUIT	1/2	GRAPEFRUIT: 1/2 SMALL	35
BEVERAGE		TEA: 1 CUP	5
LUNCH			
PROTEIN	1	TUNA OR OTHER FISH SALAD: 1/2 CUP	173
FAT	1	SALAD DRESSING: 1 TBL	65
STARCH	1	ROLLS: 1 SMALL	113
FAT	1	WITH BUTTER OR MARGARINE: 1 TSP	33
FRUIT	1	BANANA: 1 SMALL	88
BEVERAGE		COFFEE, SANKA, ETC.: 1 CUP	2
EVENING MEAL			
PROTEIN	1 1/2	BEEF: 3 OZ.	168
STARCH	1	POTATO: 2/3 CUP	124
FAT	1	WITH BUTTER OR MARGARINE: 1 TSP	33
SALAD		LETTUCE OR TOSSED SALAD: 1 CUP	22
FAT	1	SALAD DRESSING: 1 TBL	65
VEGETABLE	1	GREEN PEAS: 1/2 CUP	57
FAT	1	WITH BUTTER OR MARGARINE: 1 TSP	33
FRUIT	1/2	CANTALOUPE: 2/3 CUP	46
BEVERAGE		COFFEE, SANKA, ETC.: 1 CUP	2
THIS MEAL PLAN INCLUDES:			
2 DAIRY SERVINGS		CHEESE: 2 OZ.	210
		TOTAL CALORIES:	1444

FIG. 4. *Computer summary of a sample dietary plan.*

Table 1: Percentages of difficulties in and favorable reactions to the use of the keyboard and understanding of content during the initial teaching sequence and dietary sections of the interview

aspect of the interview	*teaching sequence of interview*			*dietary sections of interview*		
	difficulties	*favorable reactions*	*total events*	*difficulties*	*favorable reactions*	*total events*
	←			%		→
keyboard use	7	4	11	1	2	3
understanding of content	5	4	9	11	3	15
total . . .	12	8	20	12	5	18

Table 2: Percentage of item presentations with difficulties, favorable reactions, and no events of note recorded for different areas of the dietary sections of the interview

area of interview	*difficulties*	*favorable reactions*	*no events of note*
	←	%	→
weight history	9	4	87
words of encouragement	9	9	82
quantitation	12	5	82
eating habits (including binges)	13	5	82
exercise and activities	14	2	84
foods eaten	16	7	77
high caloric foods (including snacks)	19	7	74
open-ended questions	25	18	57

ics, will be needed by 1980 (9); the current graduation level is only about 1,500 per year.

The process of dietary counseling involves history-taking, teaching, and deliberate efforts to help patients change their eating behavior. Insight into factors that influence eating patterns is hard to obtain because of personal variations in food habits and the large number of foods that may be involved. Thus, the counselor in an institutional framework may have time to do little more than obtain a history. As an adjunct to counseling, the computer shows promise of helping nutritionists by obtaining a detailed history from their patients. The time saved by nutritionists could mean care offered to more patients and greater opportunity to provide education and guidance.

Our experience thus far suggests that the discipline demanded by computer interviewing may be useful in dietary counseling. Unlike the nutritionist, the computer interview does not attempt to interpret unanticipated questions or equivocal responses. In place of the open-ended, give-and-take style of a spoken interview, the computer interview must provide unambiguous questions, be specific about choices for responses, and have a planned strategy for branching to appropriate topics. The computer, therefore, demands clarity and structure from the writer. It also facilitates writing and revision by compiling a complete and detailed record of the interview.

Cumulative refinements of the interview will lead, eventually, to a standardized counseling system of known performance. Because particulars of the system will be open to public scrutiny, the nutritionist will be able to make informed decisions about its use. We plan to make the interviews responsive to questions from patients and capable of providing instruction on nutrition and guidance on self-control in eating behavior. With these additions, we believe the computer will be able to carry out most of the functions presently performed by the nutritionist and to serve alone as a dietary counselor.

Our optimism about the future of computer-based counseling has been reinforced by the participants' reactions, critical as well as favorable. People seemed to enjoy the experience and said kind things about the computer: "The machine was polite and patient," and "I see I could 'skip it' if I had some secrets." On the other hand, participants did not hesitate, as one might with a human interviewer, to express pointed and helpful criticism. The computer is, after all, immune to hurt feelings.

Comments tended to focus on several types of difficulties within the interview: limitations in the choice of responses, ambiguities and hidden meanings in the questions, and matters of courtesy. Limitations in responses, the most frequent difficulty, occurred when the interview did not offer sufficient choices to characterize the participant's dietary behavior; for example, cheese for breakfast or lemon juice on fish. The ambiguity of such common terms as "adult," "snack," and "cocktail" led to confusion and varied interpretation by participants. For example, the question "What do you think is your best weight (in pounds)?" brought the comments: "According to whom?" "My opinion or the doctor's?" and "Ideally or realistically?" Unanticipated connotations were discovered in some questions; for example, the answer choice "overweight (chubby)" to the question "How do you think your weight is?" was offensive to overweight participants who did not consider themselves chubby.

Finally, participants commented unfavorably when the interview was concluded with thanks but no farewell. A computer that attempts to maintain a polite demeanor is subject, like the human interviewer, to criticism for breaches of etiquette. This is fitting as well as proper. A machine that engages in human dialogue must be responsive to human sensitivity.

Summary

A computer-based dietary counseling system is described. Designed to interact directly with patients, the program interviews people about their dietary behavior and plans with them a weight-reducing diet of approximately 1,500 kcal. In a preliminary trial; twenty-five volunteers gave critical commentary en route through the interviews. The results provided insight into the process of dietary interviewing by computer and helped in the preparation of an experimental study (10). It is our hope that a revised and expanded version of the program will be helpful to both patients and nutritionists in the management of a variety of clinically important dietary problems.

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